How Much Energy Have Real Fields Time and Space in Multifractal Universe?

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On the base of multifractal theory of time and space (see [1]- [16]) in this paper shown presence in every space and time volumes of real space and time fields a huge supply of energy . In the multifractal Universe every space volume or time interval possesses by huge amount of energy($\sim 10^{60} cm^3$) and we discuss the problem is it possible this new for mankind sorts of energy to extract.

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I. INTRODUCTION

The fractal model of space and time [1]- [16] treats the time and the space with fractional dimensions as real fields. Universe is formed only by these fields , i.e. our Universe is fractional material time and fractional material space and include not any more. As the time and the space are material fields with fractional dimensions and multifractal structure (multifractal sets) they defined on sets of their carriers of measure. In each time (or space) point ("points" are approach for very small intervals of time or space and "intervals" are multifractal sets with global dimensions for its sets playing role of local dimensions for Universe in whole) the dimensions of time (or space) determine densities of Lagrangians energy for all physical fields (or new physical fields for space) in these points. Time and space are binding by relation $d\mathbf{r}^2 - c^2dt^2 = 0$ (this relation is only good approach, more precise relations see at [2]). As real fields time and space own huge supply of energy (the question about its energy was considered partly at [16]) and these energies may be evaluated. The purpose of this paper is more detailed consideration (in the mathematical formalism of multifractal model of time and space presented in [1]- [16]) of problem existence huge supply of energy owned by each element of time and space. The reason having energy lay in multifractal nature of time and space, i.e. multifractal nature of our Universe. Time and space formed Universe and by means of their multifractal dimensions construct picture of all physical fields and got huge amount of energy when Universe was born. In the [16] where evaluated these energies for case if current time must be turned back. In this paper we consider continually loses of these energies by time and space, evaluate values of loses energies and there is a discussion: may humankind be provided with part of these energies.

II. WHAT ARE ENERGY DENSITIES OF TIME AND SPACE REAL FIELDS IN MULTIFRACTAL UNIVERSE?

For answer on these questions it is necessary to construct and investigate equations describing behavior of very small "intervals" of space and time (in considered theory each minimal interval space or time (i.e. multifractal sets) treats as a "point" [1]- [16]). It is well known that behavior of objects with very small sizes describes by quantum laws. Equations for moving such objects are equations describing diffusion with imaginary coefficient of diffusion. Then equations for space point x_p and time point t_p may be written in the frame of multifractal theory of time and space as quantum equations with generalized fractional derivatives (GFD) [1] - [16].

$$i\hbar D_{+,t}^{1-\varepsilon_{\mathbf{r}}} x_p = m_{\mathbf{r}} c^2 x_p \tag{1}$$

and

$$i\hbar D_{+,\mathbf{r}}^{1-\varepsilon_t} t_p = m_t c^2 t_p \tag{2}$$

where $m_{\mathbf{r}}$ and m_t are rest masses time and space volumes. In (1)-(2) we used generalized fractional derivative $D_{+,t}^{d_t}$ and $D_{+,\mathbf{r}}^{d_r}$ defined on multifractal sets (see [1]- [16]). Following these works we consider both time and space as the initial real material fields existing in the world and generating all other physical fields by means of their fractal dimensions. Assume that every of them consists of a continuous, but not differentiable bounded set of small intervals (these intervals further treated as "points"). Consider the set of small time intervals S_t (their sizes may be evaluated in rude approach as Planck sizes). Let time be defined on multifractal subsets of such intervals, defined on certain measure carrier $\mathcal{R}^{\mathcal{N}}$. Each interval of these subsets (or "points") is characterized by the fractional (fractal) dimension (FD) $d_t(\mathbf{r}(t), t)$ and for different intervals FD are different. In this case the classical mathematical calculus or fractional (say, Riemann - Liouville) calculus [19] can not be applied to describe a small changes of a continuous function of physical values $f(t)$, defined on time subsets S_t, because the fractional exponent depends on the coordinates and time. Therefore, we have to introduce integral functionals (both left-sided and right-sided) which are suitable to describe the dynamics of functions defined on multifractal sets (see [1]- [3]). Actually, these functionals are simple and natural generalization of the Riemann-Liouville fractional derivatives and integrals:

$$D_{+,t}^{d} f(t) = \left(\frac{d}{dt}\right)^{n} \int_{a}^{t} \frac{f(t')dt'}{\Gamma(n-d(t'))(t-t')^{d(t')-n+1}} \tag{3}$$

$$D_{-,t}^{d} f(t) = (-1)^{n} \left(\frac{d}{dt}\right)^{n} \int_{t}^{b} \frac{f(t')dt'}{\Gamma(n-d(t'))(t'-t)^{d(t')-n+1}} \tag{4}$$

where $\Gamma(x)$ is Euler's gamma function, and a and b are some constants from $[0, \infty)$. In these definitions, as usually, $n = \{d\} + 1$, where $\{d\}$ is the integer part of d if $d \geq 0$ (i.e. $n - 1 \leq d < n$) and $n = 0$ for $d < 0$. If $d = const$, the generalized fractional derivatives (GFD) (1)-(2) coincide with the Riemann - Liouville fractional derivatives ($d \geq 0$) or fractional integrals ($d < 0$). When $d = n + \varepsilon(t)$, $\varepsilon(t) \to 0$, GFD can be represented by means of integer derivatives and integrals. For $n = 1$, that is, $d = 1 + \varepsilon$, $|\varepsilon| << 1$ it is possible to obtain:

$$D_{+,t}^{1+\varepsilon} f(\mathbf{r}(t), t) \approx \frac{\partial}{\partial t} f(\mathbf{r}(t), t) +$$
$$+ a \frac{\partial}{\partial t} \left[\varepsilon(r(t), t) f(\mathbf{r}(t), t)\right] + \frac{\varepsilon(\mathbf{r}(t), t) f(\mathbf{r}(t), t)}{t} \tag{5}$$

where a is a *constant* and determined by choice of the rules of regularization of integrals ([1]- [2], [7]) (for more detailed see [7]) and the last addendum in the right hand side of (5) is very small. The selection of the rule of regularization that gives a real additives for usual derivative in (3) yield $a = 0.5$ for $d < 1$ [1]. The functions under integral sign in (3)-(4) we consider as the generalized functions defined on the set of the finite functions [20]. The notions of GFD, similar to (3)-(4), can also be defined and for the space variables $\mathbf{r}$. The definitions of GFD (3)-(4) needs in connections between fractal dimensions of time $d_t(\mathbf{r}(t), t)$ and characteristics of physical fields (say, potentials $\Phi_i(\mathbf{r}(t), t)$, $i = 1, 2, ..$) or densities of Lagrangians L_i) and it was defined in cited works. Following [1]- [15], we define this connection by the relation

$$d_t(\mathbf{r}(t), t) = 1 + \sum_i \beta_i L_i(\Phi_i(\mathbf{r}(t), t)) \tag{6}$$

where L_i are densities of energy of physical fields, β_i are dimensional constants with physical dimension of $[L_i]^{-1}$ (it is worth to choose β'_i in the form $\beta'_i = a^{-1}\beta_i$ for the sake of independence from regularization constant). The definition of time as the system of subsets and definition of the FD for d_t (see (6)) connects the value of fractional (fractal) dimension $d_t(r(t), t)$ with each time instant t. The latter depends both on time t and coordinates $\mathbf{r}$. If $d_t = 1$ (an absence of physical fields) the set of time has topological dimension equal to unity. The multifractal model of time allows (as was be shown [5]) to consider the divergence of energy of masses moving with speed of light in the SR theory as the result of the requirement of rigorous validity of the laws pointed out in the beginning of this paper in the presence of physical fields (in the multifractal theory there are only approximate fulfillment of these laws). We bound consideration only the case when relation $d_t = 1 - \varepsilon(\mathbf{r}(t), t))$, $|\varepsilon| \ll 1$ are fulfilled. In that case the GFD (as was shown) may be represented (as a good approach) by ordinary derivatives and relation (1, (5)) are valid. So the equations (1) -(2) reeds (we used for GFD approach of (5)([16]))

$$i\hbar \frac{\partial}{\partial t} x_p - m_t c^2 x_p + + i\hbar \frac{\partial}{\partial t}[\varepsilon x_p] + i\hbar \frac{\varepsilon}{t} x_p = 0 \tag{7}$$

$$ci\hbar \frac{\partial}{\partial \mathbf{r}} t_p - m_{\mathbf{r}} c^2 t_p + + ci\hbar \frac{\partial}{\partial \mathbf{r}}[\varepsilon t_p] + ci\hbar \frac{\varepsilon}{\mathbf{r}} t_p = 0 \tag{8}$$

where c -speed of light. These equations describe behavior of the volumes with "point" sizes in time and space (we remind once more that it is only the approach that we use and in reality minimal size of time intervals and minimal sizes of space intervals in the theory are bound, for example, by Planck sizes, thou the last are multifractal sets too) For free volumes choose solutions for x_p and t_p as a plane waves with energy depending of time (we consider further only case of x_p and omit the members with masses)

$$x_p = x_0 \exp \frac{-iE(t)t}{\hbar} \tag{9}$$

and for domain of time-space where by members with $\frac{\partial \varepsilon}{\partial t}$ may neglect (i.e. fractional additives almost constant) receive ($\frac{1}{t} = P(\frac{1}{t}) - i\pi\delta(t)$, P-mean value of integral, $\delta(t)$ -δ function)

$$E(t) = -\frac{i\hbar\varepsilon_t}{t} + \frac{\hbar\varepsilon_t \pi}{t} \tag{10}$$

We do not consider the solutions of equation (8). If admit relation $x = ct$ as was admitted in [1]- [2] the energy of time "volume" will be of same order that the energy of space volume. Then (10) (or the energy of time volume from the equation (8) gives if fractal dimensions defined by gravitation field ($\varepsilon \sim 10^{-7}, t \sim 10^{17}$)

$$E \sim 10^{-51} \tag{11}$$

This energy belongs to "point" with coordinate x_p. In the considered model multifractal time and space each points is multifractal set with global dimensions d_t or d_r. Let us characterize the volumes of these points by Planck sizes: $t_p \sim 10^{-44} sec$, $x_p \sim 10^{-33} cm$. The density of energy in the one cm^3 is equal

$$E \sim 10^{60} ev \tag{12}$$

So each cubic centimeter of space has such huge energy. This gigantic energy is determined by fractional dimensions of time in the domain of space where we live. The energy determined by fractional dimensions of space $(\varepsilon(t(r), r))$ may be evaluated if find value of the fractional additives in this case. What is nature of these energies? It originates by all physical fields born by fractional dimensions of time (fractional dimensions gravitational, weak-electro-magnetic, strong interaction and so on and their vacuum). We took into account only gravitational field as example. There are vacuum states of all physical fields in any point of our Universe, they give constant additives at fractional dimensions (stress difference of vacuum physical fields from vacuum (carrier of measure) that born our Universe). Thus huge energies of space and time are constructed by the multifractal structure of our world and are consequences of multifractal nature Universe.

III. HOW MUCH ENERGIES TIME AND SPACE CONTINUALLY LOSE?

The huge supply of energy are constructed by the fractional nature of time and space . The relation (10) (or analogies relation for time volume) demonstrated diminishing of fractal structure with increasing time flow and with space expending. Both time and space tends to the state where their fractal structures tends to zero and it will the end of Universe. How much energy time lose each second? The relation (10) allows to evaluate its value. We use (10) and write

$$\triangle E \sim -\frac{\hbar \varepsilon \tau}{t_0^2} \tag{13}$$

where $\tau = t - t_0$ is a current time. So the losees space energy by one $cm^3 sec$ are

$$\triangle E \sim 10^{43} evsec \tag{14}$$

This is the huge flow of energy (in our case the flow of gravitation field energy, because we do not consider flows of other fields). Where this energy going to?

IV. WHERE THE LOSEES ENERGY GO TO? WHY WE DID NOT DISCOVERED IT TILL NOW

It seems only one the answer at the question put above exist: the flow of energy are born by diminishing of fractal structure of space and time goes directly to the carrier of measure that created our Universe. The fractal theory of time and space now are in study of construction thou main principle of it formulated and main prediction are made (see [1]- [16]). Our Universe connected (bind) with vacuum (measure carrier) and continually returns it the energy that got when "big bang" happened. So Universe must be filled of "radiation" (gravitational, electro-magnetic and so on energy flows) that it continually losing. We mention once yet that in the form of these energy flows the time and the space (Universe) directly return the energy (it is the energy they had got from the carrier of measure (physical vacuum) that born them when "big bang" had happened) back to the carrier of measure (vacuum). Universe behaves himself as a big reserver of energy strong connected with vacuum and directly return vacuum her energy. Stress that carrier of measure in considered model of fractal world not belongs our Universe (as forest not belongs Earth till it died). The Universe (Universe consists of the real fields of time and the space) only defined on the carrier of measure as part of it and may be many such Universes defined on the same carrier of measure. So time an space constantly return energy to carrier of measure in the form of energy flows diminishing the fractal structure and decreases gigantic energy of all physical fields. We can not see or sense these energies as we can not sense for example very low frequency of electro-magnetic field. For experimental discovers of these flows (time flows and space flows) it seems necessary some a new devices based on a new theory of vacuum that born our Universe and more deep penetration in the nature of time and space fields. Physics needs more knowledge about the nature of carrier of measure, characteristics of interactions between time and space fields and measure carrier. These problems may be solved in future.

V. IS IT POSSIBLE TO EXTRACT THE ENERGY FROM FIELDS OF TIME OR SPACE?

As was shown in the above paragraph the multifractal theory of time and space the real fields of time and space are filled by energy. The one cm^3 only space field is a container of the huge amount of energy because only lose of energy during one second of time consists $\sim 10^{43} ev$. The energy of rest mass is almost nothing as compared with this energy. This energy transfers directly in the measure carrier (see above paragraphs). Is it possible extract it and use for practical purpose? It is very difficult to answer on this question now because there are many non researched problems in the theory of real fractal time

and space fields. This problem is one of the main problems of the theory . If somebody asks the Neanderthal man about possibility to use for needs of his tribe the energy of water flow of near river what he will answer? He could not even understand what he was asked about. Now the method of transferring of the energy of physical fields flows directly at the energy fields of carrier of measure unknown for mankind. What new devises must be invented for discover and using these flows of energy? What new physics needs for it? Nobody can answer on these question now exactly. Nevertheless for any energetical flow must exist some of stopping flow devices that may take some of flow energies. I think early or later such devices will be invented. For it the new theory of vacuum is necessary . Now such the theory of vacuum is absent. It is necessary find out how correctly describe interactions between time and space flows, physical fields plows and measure carrier (vacuum). If it will be done (nobody knows how much time it needs) the stopping (bar) flows devices will be invented. We suppose that these problems will be solved in future then the two problem are decided:
a)the problem of sources of any amount of energy;
b) the problem of governing by time, because the taking energy from time field flow partly stopped or partly inverse the time flow.

In the beginning of the last century had appeared the known relation $E = mc^2$. It was not simple understand its influence on human life. It relation allowed humankind to develop new technology of atomic era. May be huge amount of energy condensed in the time and the space fields allow mankind in future era use it too. How to do it nobody knows now. May be very intensive beams of electro-magnetic field energy received by means of beams of particles moving with speed of light (see [4]) allow to do "the opening" in the time field and to receive from it energy? Is it is possible to use the energy of long wave" vibrations" that filled Universe? Optimistic point of view allows to have hope that in future these new sources of energy when energy may be got directly from time and space fields flows (in case that the fractal theory of time and space will find experimental verification) may be used.

VI. CONCLUSIONS

1.The multifractal theory of time and space forecast existence of gigantic supply of energy in the real time and space fields (the order of these losees is $10^{60} evsec$);
2. The multifractal theory of time and space forecast existence of gigantic losees of energy by each volumes of space and time (the order of these losees is $10^{43} evsec$);
3. Discussion of possibilities to use the huge supply of time field and space field energies by humankind gives more optimistic then pessimistic perspective for future of mankind.

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